DESCRIPTION

DATA PROCESSING APPARATUS, THE METHOD AND CODING

APPARATUS

TECHNICAL FIELD

[0001]   The present invention relates to a data

processing apparatus, the method and a coding apparatus

for performing quantization on image data.

BACKGROUND ART

[0002]   In recent years, apparatuses based on methods,

such as the Moving Picture Experts Group (MPEG) for using

image data as digital and compressing by discrete cosine

transformation and other orthogonal transformations and

motion compensation by using redundancy peculiar to image

information for the purpose of efficiently transferring

and accumulating information, have been widespread both

in information distribution by broadcast stations and in

information receiving by general households. In the MPEG

method, transformation coefficients are generated by

performing orthogonal transformation on image data to be

coded and quantization is performed on the transformation

coefficients by a predetermined quantization scale, and

then the quantized image data are coded.

In the MPEG method, the quantization scale is

determined based on a degree of complexity of an image to be coded, so that the more complex the image becomes, the smaller the value becomes.

[0003]   Following to the MPEG method, coding methods called the H.264 and JVT (Joined Video Team) for realizing a still higher compression rate have been proposed.

In the JVT method coding apparatus, coding in the JVT method is performed after decoding image data coded by the MPEG in some cases.

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0004]   When performing quantization without considering a quantization scale used in the MPEG method coding apparatus in the JVT method coding apparatus of the related art explained above, there is a disadvantage that, for example, an extremely larger quantization scale than the quantization scale used in the MPEG method coding apparatus is selected and information held by the MPEG method is lost by rough quantization, so that the image quality is deteriorated in some cases.

Inversely, there is a disadvantage in the JVT method coding apparatus of the related art explained above that an extremely smaller quantization scale than the quantization scale used in the MPEG method coding

apparatus is selected and a large number of bits are

assigned to less information, so that the coding

efficiency declines without improving the image quality.

The same disadvantages may arise also in coding

5   methods other than the MPEG method and the JVT method.

[0005]   It is desired to provide a data processing

apparatus, the method and a coding apparatus for, when

performing second quantization on data to be processed

and obtained by performing inverse quantization after

10 performing first quantization, suitably performing the

above second quantization in terms of image quality and a

coding efficiency.

MEANS OF SOLVING THE PROBLEMS

[0006]   To solve the above disadvantages of the

15 related art explained above, according to a first

invention, there is provided a data processing apparatus

for performing a second quantization on data to be

processed and obtained by performing inverse quantization

after performing a first quantization by a first

20 quantization scale, comprising a quantization scale

generation means for generating a second quantization

scale based on the first quantization scale; and a

quantization means for performing the second quantization

on the data to be processed based on the second

25 quantization scale generated by the quantization scale

generation means.

[0007]   An operation of the data processing apparatus
of the first invention is as below.

First, the quantization scale generation means
generates the second quantization scale based on the
first quantization scale,

Next, the quantization means performs the second
quantization on the data to be processed based on the
second quantization scale generated by the quantization
scale generation means.

[0008]   According to a second invention, there is
provided a data processing method for performing the
second quantization on data to be processed and obtained
by performing inverse quantization after performing the
first quantization by the first quantization scale,
including: a first step of generating a second
quantization scale based on the first quantization scale;
and a second step of performing the second quantization
on the data to be processed based on the second
quantization scale generated in the first step.

[0009]   According to a third invention, there is
provided a coding apparatus, comprising a decoding means
for generating decoding data by decoding coding data
generated by performing coding on motion image data by
the first coding method and obtained by performing the

first quantization based on the first quantization scale

in the coding step; the quantization scale generation

means for generating the second quantization scale based

on the first quantization scale; and a quantization means

5   for performing second quantization on the decoding data

based on the second quantization scale generated by the

quantization scale generation means in a step of

performing coding in a second coding method which is

different from the first coding method on the decoding

10   data generated by the decoding means.

[0010]   An operation of the coding apparatus of the

third invention is as below.

First, a decoding means generates decoding data by

decoding coding data generated by performing coding on

15   moving image data by the first coding method and obtained

by performing the first quantization based on the first

quantization scale in the above coding step.

Next, the quantization scale generation means

generates the second quantization scale based on the

20   first quantization scale.

Next, the quantization means performs the second

quantization on the decoding data based on the second

quantization scale generated by the quantization scale

generation means in a step of coding the decoding data

25   generated by the decoding means by a second coding method

which is different from the first coding method.

[0011]   According to a fourth invention, there is

provided a data processing apparatus for performing the

second quantization on data to be processed and obtained

5   by performing the inverse quantization after performing

the first quantization by the first quantization scale,

comprising the quantization scale generation circuit for

generating a second quantization scale based on the first

quantization scale; and the quantization circuit for

10   performing the second quantization on the data to be

processed based on the second quantization scale

generated by the quantization scale generation circuit.

EFFECT OF THE INVENTION

[0012]   According to the present invention, when

15   performing second quantization on data to be processed

and obtained by performing inverse quantization after

performing the first quantization, it is possible to

provide a data processing apparatus, the method and a

coding apparatus for suitably performing the second

20   quantization in terms of image quality and a coding

efficiency.

BRIEF DESCRIPTION OF DRAWINGS

[0013]   FIG. 1 is a view of the configuration of a

communication system according to a first embodiment of

25   the present invention;

FIG. 2 is a functional block diagram of a coding apparatus shown in FIG. 1;

FIG. 3A and FIG. 3B are views for explaining frame coding and field coding used in the MPEG2 method;

5   FIG. 4A and FIG. 4B are views for explaining frame coding and field coding in unit of picture used in the JVT method;

FIG. 5 is a view for explaining frame coding and field coding in unit of macro block used in the JVT

10   method;

FIG. 6 is a view for explaining processing of performing field coding on MPEG image data in unit of picture in the JVT method;

FIG. 7 is a view for explaining processing for

15   performing field coding on MPEG image data in unit of macro block in the JVT method;

FIG. 8 is a view for explaining processing in an activity calculation circuit shown in FIG. 2 when performing field coding in unit of picture as shown in

20   FIG. 6 in the coding apparatus 2 shown in FIG. 2;

FIG. 9 is a view for explaining an operation example on determination of a quantization scale and quantization in the coding apparatus shown in FIG. 2; and

FIG. 10 is a flowchart for explaining processing of

25   the activity calculation circuit shown in FIG. 2 when

performing field coding in unit of macro block pair as

shown in FIG. 7 in the coding apparatus 2 shown in FIG. 2.

EXPLANATION OF REFERENCE

[0014]   1... COMMUNICATION SYSTEM, 2... CODING

5   APPARATUS, 3... DECODING APPARATUS, 22... A/D CONVERSION

CIRCUIT, 23... PICTURE RELOCATING CIRCUIT, 24...

CALCULATION CIRCUIT, 25... ORTHOGONAL TRANSFORMATION

CIRCUIT, 26... QUANTIZATION CIRCUIT, 27...

REVERSIBLE(LOSSLESS) CODING CIRCUIT, 28... BUFFER, 29...

10 INVERSE QUANTIZATION CIRCUIT, 30... INVERSE ORTHOGONAL

TRANSFORMATION CIRCUIT, 31... RESTRUCTURING CIRCUIT, 32...

DEBLOCK FILTER, 33... MEMORY, 41... INTRA PREDICTION

CIRCUIT, 42... MOTION PREDICTION/COMPENSATION CIRCUIT,

51... MPEG2 DECODING CIRCUIT, 52... PICTURE TYPE BUFFER,

15 53... ACTIVITY CALCULATION CIRCUIT, 54... RATE CONTROL

CIRCUIT

BEST MODE FOR CARRYING OUT THE INVENTION

[0015]   Below, a JVT method coding apparatus

according to embodiments of the present invention will be

20 explained.

First Embodiment

In the present embodiment, a JVT method coding

apparatus will be explained with reference to FIG. 1 to

FIG. 9.

25   First, corresponding relationship of components of

the present invention and components of the present

embodiment will be explained.

In the present embodiment, a function of generating

a quantization scale based on a quantization parameter QP

5   among functions of an activity calculation circuit 53, a

rate control circuit 54 and a quantization circuit 26

corresponds to a quantization scale generation means of

the first and third inventions.

Also, a function of performing quantization based

10 on the quantization scale in functions of the

quantization circuit 26 in the present embodiment

corresponds to a quantization means of the first and

third inventions.

Also, an MPEG2 decoding circuit 51 in the present

15 embodiment corresponds to a decoding means of the third

invention.

[0016]   FIG. 1 is a conceptual view of a

communication system 1 of the present embodiment.

As shown in FIG. 1, the communication system 1 has

20 a coding apparatus 2 provided on the transmission side

and a decoding apparatus 3 provided on the receiving side.

In the communication system 1, in the coding

apparatus 2 on the transmission side, after generating

frame image data (bit stream) compressed by orthogonal

25 transformation, such as discrete cosine transformation

and Karhunen-Loeve transformation, and motion

compensation and modulating the frame image data, it is

transmitted via transmission media, such as a satellite

broadcast wave, a cable TV network, a telephone line

5   network and a cellular phone network.

On the receiving side, after decoding a received

image signal, frame image data decompressed by inverse

transformation of the orthogonal transformation at the

time of the above modulation and motion compensation is

10   generated and used.

Note that the transmission media may be recording

media, such as an optical disk, a magnetic disk and a

semiconductor memory.

A decoding apparatus 3 shown in FIG. 1 performs

15   decoding in accordance with coding by the coding

apparatus.

[0017]   Below, the coding apparatus 2 shown in FIG. 1

will be explained.

FIG. 2 is a view of the overall configuration of

20   the coding apparatus 2 shown in FIG. 1.

As shown in FIG. 2, the coding apparatus 2 includes,

for example, an A/D conversion circuit 22, a picture

relocating circuit 23, a calculation circuit 24, an

orthogonal transformation circuit 25, a quantization

25   circuit 26, a reversible coding circuit 27, a buffer 28,

an inverse quantization circuit 29, an inverse orthogonal

transformation circuit 30, a restructuring circuit 31, a

deblock filter 32, a memory 33, an intra prediction

circuit 41, a motion prediction/compensation circuit 42,

5   a selection circuit 44, an MPEG2 decoding circuit 51, a

picture type buffer memory 52, an activity calculation

circuit 53 and a rate control circuit 54.

[0018]   Below, an outline of the coding apparatus 2

will be explained.

10   In the coding apparatus 2, an MPEG image data S11

coded by the MPEG2 in the MPEG2 decoding circuit 51 is

decoded to generate image data S51, and the image data

S51 is coded by the JVT method.

The MPEG2 decoding circuit 51 extracts a

15   quantization scale Qm (first quantization scale of the

present invention) of each macro block MB used in

quantization in the MPEG2 coding step (first quantization

of the present invention) from the MPEG image data S11

and outputs to the activity calculation circuit 53.

20   The activity calculation circuit 53 calculates an

activity "Nact" based on the quantization scale Qm and

outputs the same to the rate control circuit 54 as will

be explained later on.

The rate control circuit 54 calculates a

25   quantization parameter QP of each macro block MB based on

the activity "Nact" input from the activity calculation

circuit 53 and outputs the same to the quantization

circuit 26.

The quantization circuit 26 performs quantization

5 (the second quantization of the present invention) on the

image data S25 by using a quantization scale (the second

quantization scale of the present invention) determined

based on the quantization parameter QP input from the

rate control circuit 54.

10 [0019]   Next, MPEG2 and JVT coding methods will be

explained.

In either of the MPEG2 and JVT, there are non-

interlace scanning image data and interlace scanning

image data in image data input to the coding apparatus,

15 and it is possible to select coding in unit of field data

(field coding) and coding in unit of frame data (frame

coding).

In the MPEG2, frame coding may be performed on a

macro block MB composed of data of 16 pixels by 16 pixels,

20 for example, as shown in FIG. 3A, or field coding may be

performed on each top field data and bottom field data by

dividing to data of 16 pixels by 8 pixels as shown in FIG.

3B.

[0020]   Also, in the JVT, it is possible to select

25 coding in unit of picture as shown in FIG. 4A and FIG. 4B

and coding in unit of macro block as shown in FIG. 5.

As coding in unit of picture, it is possible to select frame coding shown in FIG. 4A and field coding shown in FIG. 4B.

5   Also, as coding in unit of macro block, it is possible to select the case of performing frame coding or field coding in unit of single macro block and the case of performing frame coding or field coding in unit of two macro blocks MB (MB pair), that is data of 16 pixels by 10   32 pixels.

[0021]   Also, in the present embodiment, as shown in FIG. 6, respective macro blocks MB(i) and MB(i+1) adjacent in the vertical direction in frame data FR_m composing the image data S51 obtained by decoding in the 15   MPEG2 decoding circuit 51 are quantized based on quantization scales Qm(i) and Qm(i+1), respectively, in MPEG coding performed in the past.

The MPEG2 decoding circuit 51 extracts the quantization scales Qm(i) and Qm(i+1) in the step of 20   decoding the MPEG image data S11 and outputs to the activity calculation circuit 53.

Note that each of the macro blocks MB in the MPEG image data S11 corresponding to the macro blocks MB(i) and MB(i+1) includes both of the quantization scales 25   Qm(i) and Qm(i+1).

[0022]   Also, when field coding in unit of picture by the JVT method is performed, JVT image data S2 includes in a macro block MBjt(i) in a top field TF_j corresponding to a macro block MBm(i) a quantization scale Qjt(i) used in the quantization as shown in FIG. 6. Also, in a macro block MBjb(i) in a bottom field BF_j corresponding to a macro block MBm(i+1), a quantization scale Qjb(i) used in the quantization is included.

[0023]   On the other hand, furthermore, when field coding in unit of macro block pair by the JVT method is performed, in JVT image data S2, as shown in FIG. 7, a macro block MBj(i) corresponding to the macro block MBm(i) and a macro block MBj(i+1) corresponding to the macro block MBm(i+1) are arranged in the same field FI_j.

     The macro block MBj(i) includes a quantization scale Qj(i) used in the quantization, and the macro block MBj(i+1) includes a quantization scale Qj(i+1) used in the quantization.

[0024]   Below, components of the coding apparatus 2 will be explained.

     The A/D conversion circuit 22 converts image data S10 to be coded and composed of input analog luminance signal Y and color-difference signals Pb and Pr to image data S22 in digital, and outputs the same to the picture relocating circuit 23.

The screen relocating circuit 23 outputs image data S23 obtained by relocating image data S22 input from the A/D conversion circuit 22 or image data S51 input from the MPEG2 decoding circuit 51 in an order of coding in

5 accordance with the GOP (group of pictures) structure composed of the picture types I, P and B to the calculation circuit 24, the intra prediction circuit 41 and the motion prediction/compensation circuit 42.

Below, in the present embodiment, the case where

10 the screen relocating circuit 23 performs processing on image data S51 input from the MPEG2 decoding circuit 51.

[0025]   The calculation circuit 24 generates image data S24 indicating a difference between the image data S23 and prediction image data PI input from a selection

15 circuit 44 and outputs the same to the orthogonal transformation circuit 25.

The orthogonal transformation circuit 25 performs orthogonal transformation, such as discrete cosine transformation and Karhunen-Loeve transformation, on the

20 image data S24 to generate image data (for example, a DCT coefficients) S25 and outputs the same to the quantization circuit 26.

The quantization circuit 26 performs quantization on the image data S25 based on the quantization scale

25 regulated based on the quantization parameter QP input

from the rate control circuit 32 and in accordance with

the quantization parameter QP to generate image data S26

and outputs the same to the reversible coding circuit 27

and inverse quantization circuit 29.

5 [0026]   The reversible coding circuit 27 stores in

the buffer 28 image data obtained by performing variable

length coding or calculation coding on the image data S26.

At this time, when the selection data S44 indicates

that inter prediction coding is selected, the reversible

10 coding circuit 27 performs coding on a motion vector MV

input from the motion prediction/compensation circuit 58

and stores the same in the header data.

Alternately, when selection data S44 indicates that

intra prediction coding is selected, the reversible

15 coding circuit 27 stores an intra prediction mode IPM

input from the intra prediction circuit 41 in the header

data, etc.

Also, the reversible coding circuit 27 makes the

quantization scale used in quantization in the

20 quantization circuit 26 included in respective macro

blocks MB.

[0027]   Image data stored in the buffer 28 is

transmitted after being modulated, etc.

The inverse quantization circuit 29 performs

25 inverse quantization on the image data S26 based on the

quantization scale used in the quantization circuit 26

and outputs the same to the inverse orthogonal

transformation circuit 30.

   The inverse orthogonal transformation circuit 30

5 performs inverse orthogonal transformation corresponding

to the orthogonal transformation used in the orthogonal

transformation circuit 25 on inversely quantized image

data input from the inverse quantization circuit 29 and

outputs the same to the restructuring circuit 31.

10   The restructuring circuit 31 adds prediction image

data PI input from the selection circuit 44 and image

data input from the inverse orthogonal transformation

circuit 30 to generate restructuring image data and

outputs the same to the deblock filter 32.

15   After eliminating block strain of image data input

from the restructuring circuit 31, the deblock filter 32

writes the same as reference image data in the memory 33.

   [0028]   The intra prediction circuit 41 performs

intra prediction coding on the respective macro blocks MB

20 composing image data read from the memory 33 to generate

prediction image data, for example, based on respective

intra prediction modes regulated in advance by the JVT

and detects a difference DIF between the prediction image

data and the image data S23.

25   Then, the intra prediction circuit 41 specifies an

intra prediction mode corresponding to the minimum

difference in the above difference generated respectively

for the above plurality of intra prediction modes and

outputs the specified intra prediction mode IPM to the

5   reversible coding circuit 27.

Also, the intra prediction circuit 41 outputs the

prediction image data PI by the specified intra

prediction mode and the difference DIF to the selection

circuit 44.

10   [0029]   The motion prediction/compensation circuit 42

performs motion prediction processing in unit of frame

data and field data on the image data S23 as explained

with reference to FIG. 4 and FIG. 5 and determines a

motion vector MV based on the reference image data REF

15   read from the memory 33.

Namely, the motion/compensation circuit 42

determines a motion vector MV to make the difference DIF

between prediction image data PI regulated by the motion

vector MV and the reference image data REF and the image

20   data S23 minimum.

The motion prediction/compensation circuit 42

outputs the prediction image data PI and the difference

DIF to the selection circuit 44 and outputs the motion

vector MV to the reversible coding circuit 27.

25   Note that the motion prediction/compensation

circuit 42 performs motion prediction/compensation

processing on the respective frame data and field data

based on picture type data PIC_T read from the picture

type buffer memory 52 by applying the same picture type

5   used in the MPEG coding.

The selection circuit 44 compares the difference

DIF input from the intra prediction circuit 41 and the

difference DIF input from the motion

prediction/compensation circuit 42.

10   When the selection circuit 44 determines that the

difference DIF input from the intra prediction circuit 41

is smaller from the above comparison, it selects the

prediction image data PI input from the intra prediction

circuit 41 and outputs to the calculation circuit 24.

15   [0030]   When the selection circuit 44 determines that

the difference DIF input from the motion

prediction/compensation circuit 42 is smaller from the

above comparison, it selects the prediction image data PI

input from the motion prediction/compensation circuit 58

20   and outputs to the calculation circuit 24.

Also, the selection circuit 44 outputs to the

reversible coding circuit 27 selection data S44

indicating that inter prediction coding is selected when

the prediction image data PI input from the intra

25   prediction circuit 41 is selected, while outputs to the

reversible coding circuit 27 selection data S44

indicating that intra prediction coding is selected when

the prediction data PI input from the motion

prediction/compensation circuit 58 is selected.

5   [0031]   The MPEG2 decoding circuit 51 receives as an

input, for example, MPEG image data S11, and decodes the

MPEG image data S11 by the MPEG2 to generate image data

S51 and outputs the same to the screen relocating circuit

23.

10   Also, the MPEG2 decoding circuit 51 writes in the

picture type buffer memory 52 the picture type data PIC_T

included in a header of the image data S11 and indicating

a picture kind of each macro block.

        The MPEG2 decoding circuit 51 extracts a

15   quantization scale Qm of the each macro block used in the

quantization in the MPEG2 coding step from the MPEG image

data S11 in the above decoding and outputs to the

activity calculation circuit 53.

        [0032]   The picture type data PIC_T stored in the

20   picture type buffer memory 52 is read by the selection

circuit 44 and the motion prediction/compensation circuit

58.

        [0033]   The activity calculation circuit 53

calculates an activity Nact based on the quantization

25   scale Qm input from the MPEG2 decoding circuit 51 and

outputs the same to the rate control circuit 54. FIG. 8

is a view for explaining processing in the activity

calculation circuit 53 shown in FIG. 2 when performing

field coding in unit of picture as shown in FIG. 6 in JVT

5   coding.

Below, an explanation will be made by taking as an

example calculation of the activity Nact used for

generating macro blocks MBjt(i) and MBjb(t) in the JVT

image data S2 shown in FIG. 6.

10   Step ST11:

The activity calculation circuit 53 receives as an

input a quantization scale Qm(i) of the macro block

MBm(i) and a quantization scale Qm(i+1) of a macro block

MBm(i+1) shown in FIG. 6 from the MPEG2 decoding circuit

15   51.

The activity calculation circuit 53 receives as an

input the quantization scales Qm(i) and Qm(i+1) as

arguments of a function ft() shown in the formula (1)

below regulated in advance for a top field TF_j and

20   specifies a quantization scale Qa_t(i).

[0034]   [Formula 1]

$$Qa\_t(i) = ft(Qm(i), Qm(i+1))$$

$$...(1)$$

[0035]   The activity calculation circuit 53 receives

as an input the quantization scales $Qm(i)$ and $Qm(i+1)$ as

arguments of a function fb() shown in the formula (2)

regulated in advance for a bottom field BF_j and

5   specifies a quantization scale $Qa\_b(i)$.

[0036]   [Formula 2]

$$Qa\_b(i) = fb(Qm(i), Qm(i+1))$$
$$...(2)$$

[0037]   As the ft() and fb(), for example as shown in

the formula (3), the smaller of the quantization scales

$Qm(i)$ and $Qm(i+1)$ is selected and used for a function for

10   specifying the quantization scales $Qa\_t(i)$ and $Qa\_b(i)$.

[0038]   [Formula 3]

$$Qa\_t(i) = Qa\_b(i) = min(Qm(i), Qm(i+1))$$
$$...(3)$$

[0039]   Note that as the functions ft() and fb(), for

example, a function for calculating the quantization

scales $Qa\_t(i)$ and $Qa\_b(i)$ by calculation shown in the

15   formula (4) below.

[0040]   [Formula 4]

$$Qa\_t(i)=Qa\_b(i)=(Qm(i)+Qm(i+1)+1)/2$$

$$...(4)$$

[0041]   Step ST12:

The activity calculation circuit 53 calculates an average value aveQa_t of quantization scales Qa_t(i) of all block data in the top field TF_j, to which the macro

5   block MBjt(i) belongs, based on the formula (5) below.

[0042]   [Formula 5]

$$aveQa\_t=(1/N)\sum_{i\in\Omega t}Qa\_t(i)$$

$$...(5)$$

[0043]   Also, the activity calculation circuit 53 calculates an average value aveQa_b of quantization scales Qa_b(i) of all block data in the bottom field BF_j,

10   to which the macro block MBjb(i) belongs, based on the formula (6) below.

[0044]   [Formula 6]

$$aveQa\_b=(1/N)\sum_{i\in\Omega B}Qa\_b(i)$$

$$...(6)$$

[0045]   Step ST13:

The activity calculation circuit 53 calculates

15   activity Nact_t(i) by dividing the quantization scale

Qa_t(i) calculated in the step ST11 by the average value

aveQa_t calculated in the step ST12 for each of the macro

blocks MB belonging to the top field TF_j as shown in the

formula (7) below.

5   [0046]   [Formula 7]

$$Nact\_t(i) = Qa\_t(i) / aveQa\_t \qquad \ldots(7)$$

[0047]   Also, the activity calculation circuit 53

calculates activity Nact_b(i) by dividing the

quantization scale Qa_b(i) calculated in the step ST11 by

the average value aveQa_b calculated in the step ST12 for

10   each of the macro blocks MB belonging to the bottom field

BF_j as shown in the formula (8) below.

[0048]   [Formula 8]

$$Nact\_b(i) = Qa\_b(i) / aveQa\_b \qquad \ldots(8)$$

[0049]   Step ST14:

The activity calculation circuit 53 outputs the

15   activities Nact_t(i) and Nact_b(i) calculated in the step

ST13 to the rate control circuit 54.

[0050]   The rate control circuit 54 calculates a

quantization parameter QP for each macro block MB based

on the activities Nact_t(i) and Nact_b(i) input from the

activity calculation circuit 53 and outputs the same to the quantization circuit 26.

Here, when expressing the activities Nact_t(i) and Nact_b(i) by the activity Nact(i), a quantization

5   parameter QP(i) of each macro block MB is expressed by the formulas (9) and (10) below. Note that "round" in the formula (9) indicates integer processing by rounding, and "QPr" in the formula (10) is a reference quantization parameter regulated by the JVT method, which is regulated

10 for field data or frame data.

[0051]   [Formula 9]

$$\Delta QP = round(\log_{1.12} Nact(i))$$

$$...(9)$$

[0052]   [Formula 10]

$$QP(i) = QPr + \Delta QP$$

$$...(10)$$

[0053]   The rate control circuit 54 outputs a quantization parameter QP(i) generated as explained above

15 to the quantization circuit 26.

The quantization circuit 26 performs quantization on the image data S25 by a quantization scale regulated in accordance with the quantization parameter QP(i) input from the rate control circuit 54 to generate image data

S26.

Note that, in the present embodiment, the quantization scale is regulated to be doubled when the quantization parameter QP(i) increases by "6".

[0054]   FIG. 9 is a view for explaining an operation example of the coding apparatus 2 regarding determination of a quantization scale and quantization.

Step ST21:

The MPEG2 decoding circuit 51 extracts a quantization scale Qm of each macro block used in quantization in an MPEG2 coding step from the MPEG image data S11 in the decoding above and outputs to the activity calculation circuit 53.

Step ST22:

The activity calculation circuit 53 calculates activities Nact(Nact_t(i) and Nact_b(i)) based on the quantization scale Qm input from the MPEG2 decoding circuit 51 in the step ST21 and outputs the same to the rate control circuit 54.

Step ST23:

The rate control circuit 54 calculates a quantization parameter QP of each macro block MB based on the activity Nact input from the activity calculation circuit 53 in the step ST22 and outputs the same to the quantization circuit 26.

Step ST24:

The quantization circuit 26 performs quantization on the image data S25 by a quantization scale regulated in accordance with the quantization parameter QP(i) input from the rate control circuit 54 in the step ST23 to generate image data S26.

[0055]   Below, an example of an overall operation of the coding apparatus 2 when coding by the JVT method the image data S51 obtained by decoding the MPEG image data S11 will be explained.

First, the MPEG image data S11 coded by the MPEG2 is input to the MPEG2 decoding circuit 51.

Next, the MPEG2 decoding circuit 51 decodes the MPEG image data S11 to generate the image data S51 and outputs the same to the screen relocating circuit 23.

At this time, the MPEG2 decoding circuit 51 extracts a quantization scale Q_m of each macro block used in quantization in the MPEG2 coding step from the MPEG image data S11 in the above decoding and outputs the same to the activity calculation circuit 53.

Then, the activity calculation circuit 53 calculates an activity Nact based on the quantization scale Q_m and outputs the same to the rate control circuit 54.

Then, the rate control circuit 54 calculates a

quantization parameter QP of each macro block MB based on

the activity Nact and outputs the same to the

quantization circuit 26.

[0056]   Also intra prediction is performed in the

5   intra prediction circuit 41 and a difference DIF with the

prediction image data PI is output to the selection

circuit 44.

Also, in the motion prediction/compensation circuit

42, motion prediction/compensation processing is

10 performed and a motion vector MV is specified, and the

prediction image data PI and the difference DIF are

output to the selection circuit 44.

Then, the selection circuit 44 outputs prediction

image data PI corresponding to the smaller difference DIF

15 of the difference DIF input from the intra prediction

circuit 41 and the difference DIF input from the motion

prediction/compensation circuit 58 to the calculation

circuit 24.

[0057]   Next, the calculation circuit 24 generates

20 image data S24 indicating a difference between the image

data S23 and the prediction image data PI input from the

selection circuit 44 and outputs the same to the

orthogonal transformation circuit 25.

Next, the orthogonal transformation circuit 25

25 performs orthogonal transformation, such as discrete

cosine transformation and Karhunen-Loeve transformation,

on the image data S24 to generate image data (for example

a DCT coefficients) S25 and outputs the same to the

quantization circuit 26.

5   Next, the quantization circuit 26 performs

quantization on the image data S25 based on the

quantization scale regulated in accordance with the

quantization parameter QP based on the quantization

parameter QP input from the rate control circuit 32, and

10   outputs the same to the reversible coding circuit 27 and

the inverse quantization circuit 29.

Next, the reversible coding circuit 27 stores in

the buffer 28 the image data obtained by performing

variable length coding or calculation coding on the image

15   data S26.

[0058]   As explained above, in the coding apparatus 2,

when performing JVT coding on the image data S51 decoded

in the MPEG2 decoding circuit 51, a quantization

parameter QP (quantization scale) of each macro block

20   used for quantization of the quantization circuit 26

based on the quantization scale Qm used for generating

each macro block MBm of MPEG image data is determined.

Therefore, according to the coding apparatus 2, it

is possible to perform high quality quantization with

25   less waste in the JVT coding by considering

characteristics of quantization in the MPEG coding

comparing with the case of determining a quantization

parameter QP to be used for quantization by the

quantization circuit 26 without using a quantization

5   scale Qm.

[0059]   Also, according to the coding apparatus 2, as

explained above, quantization scales $Qa\_t(i)$ and $Qa\_b(i)$

are generated based on the quantization scales $Qm(i)$ and

$Qm(i+1)$ as shown in the above formulas (3) and (4) in the

10 activity calculation circuit 53, and by determining a

quantization scale to be used in the quantization circuit

26 based thereon, it is possible to prevent selecting an

extremely larger or smaller quantization scale than the

quantization scale used in the MPEG method coding in

15 quantization in the JVT method coding.

Therefore, according to the coding apparatus 2, it

is possible to perform suitable quantization in the

quantization circuit 26 in terms of image quality and a

coding efficiency. Namely, it is possible to prevent in

20 the JVT coding a wasteful loss of information held in

MPEG coding or assignment of an unnecessarily large

amount of bits to information already lost in the MPEG

coding.

[0060]   Second Embodiment

25   In the above first embodiment, an explanation was

made on the processing of the activity calculation

circuit 53 shown in FIG. 2 in the case of performing

field coding in unit of picture as shown in FIG. 6.

In the present embodiment, an explanation will be

5   made on processing of the activity calculation circuit 53

shown in FIG. 2 when performing field coding in unit of

micro block as shown in FIG. 7.

FIG. 10 is a flowchart for explaining processing of

the activity calculation circuit 53 show in FIG. 2 when

10   performing field coding in unit of macro block as shown

in FIG. 7.

Below, calculation of activity Nact of macro blocks

MBj(i) and MBj(i+1) in JVT image data S2 shown in FIG. 7

will be explained as an example.

15   Step ST31:

The activity calculation circuit 53 receives as an

input a quantization scale $Qm(i)$ of the macro block

MBm(i) and a quantization scale $Qm(i+1)$ of the macro

block MBm(i+1) shown in FIG. 6 from the MPEG2 decoding

20   circuit 51.

The activity calculation circuit 53 receives as an

input the quantization scales $Qm(i)$ and $Qm(i+1)$ as

arguments of the function f1() shown in the formula (11)

below and specifies a quantization scale $Qa(i)$.

25   [0061]   [Formula 11]

$$Qa(i) = f1(Qm(i), Qm(i+1))$$

$$\dots (11)$$

[0062]   Also, the activity calculation circuit 53

receives as an input the quantization scales $Qm(i)$ and

$Qm(i+1)$ as arguments of the function f2() shown in the

formula (12) below and specifies a quantization scale

5   $Qa(i+1)$.

[0063]   [Formula 12]

$$Qa(i+1) = f2(Qm(i), Qm(i+1))$$

$$\dots (12)$$

[0064]   As the functions f1() and f2(), for example,

those as same as the above formulas (3) and (4) are used.

[0065]   Step ST32:

10   The activity calculation circuit 53 calculates an

average value aveQa of quantization scales $Qa(i)$ and

$Qa(i+1)$ of all block data in the field FI_j, to which the

macro blocks $MBj(i)$ and $MBj(i+1)$ belong, based on the

formula (13) below.

15   [0066]   [Formula 13]

$$aveQa = (1/N) \sum_{i \in \Omega} Qa(i)$$

$$\dots (13)$$

[0067]   Step ST33:

The activity calculation circuit 53 calculates an activity Nact(i) by dividing the quantization scale Qa(i) calculated in the step ST31 by the average value aveQa calculated in the step ST32 as shown in the formula (14) below.

[0068]   [Formula 14]

$$\text{Nact(i)} = \text{Qa(i)} / \text{aveQa}$$

$$...(14)$$

[0069]   Also, the activity calculation circuit 53 calculates an activity Nact(i+1) by dividing the quantization scale Qa(i+1) calculated in the step ST41 by the average value aveQa calculated in the step ST32 as shown in the formula (15) below.

[0070]   [Formula 15]

$$\text{Nact(i+1)} = \text{Qa(i+1)} / \text{aveQa}$$

$$...(15)$$

[0071]   Step ST34:

The activity calculation circuit 53 outputs the activities Nact(i) and Nact(i+1) calculated in the step ST33 to the rate control circuit 54.

[0072]   The same effects as those in the first embodiment can be obtained also in the present embodiment.

[0073]   The present invention is not limited to the

above embodiments.

For example, in the above embodiments, in the

coding apparatus 2, the case of performing field coding

5   by the JVT method was explained as an example, but frame

coding may be performed.

In this case, for example, in the step ST12 shown

in FIG. 8, the activity calculation circuit 53 calculates

an average value aveQa of quantization scales Qa of all

10   block data in the frame data, to which the macro block

belongs, and based thereon, an activity Nact is generated.

Also, in the above embodiments, motion image data

was explained as an example of data to be processed in

the present invention, but data to be processed in the

15   present invention may be still image data or audio data.

INDUSTRIAL APPLICABILITY

[0074]   The present invention can be applied to

coding systems for coding image data.

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